Are we seeing more space weather?

Description

Space weather might be a lesser-known forecast from the Met Office, but predicting the occurrence of solar flares, solar radiation storms and coronal mass ejections is vital for range of critical sectors from satellite providers to the aviation industry, as well as for forecasting Aurora Borealis sightings.

In recent weeks aurora sightings have been in the news again, with some as far south as Cardiff reportedly capturing photos of the Northern Lights, which is often the way most of the public is inadvertently aware of space weather.

Image: Grahame Soden, Royal Photographic Society

Has there been more Aurora Borealis activity recently?

In short, yes. But the explanation is well known in the science community and a further increase in space weather activity is expected in the coming years.

Krista Hammond is a Manager at the Met Office Space Weather Operations Centre (MOSWOC). She said: “Activity on the sun, and in particular the number of visible sunspots, varies over roughly an 11-year period, known as the solar cycle.”

The last solar minimum – when the Sun had the lowest frequency of visible sunspots in the solar cycle – occurred in December 2019. This means that the sun’s activity is currently increasing, with the next solar maximum expected around 2025.

Krista added: “Over the coming years, as we continue towards the solar maximum, we can expect to see an increase in the frequency of space weather events, with more chances to see the Aurora Borealis over the UK.”

Finding space to forecast

MOSWOC is one of a handful of 24/7 space weather forecasting centres in the world, with expert forecasters focused on predicting the arrival of impactful space weather events on Earth.

Despite the somewhat predictable nature of the 11-year solar cycle, forecasting specific space weather events can be more challenging, as you might expect when predicting an event on Earth that begins on the Sun around 150 million kilometres away.

Solar flares are sudden releases of energy across the entire electromagnetic spectrum. They are hard to predict, and the energy can be detected in Earth’s atmosphere as soon as 8.5 minutes after the occurrence of a solar flare.

Linked with large flares, solar radiation storms may also occur. These consist of high-energy charged particles, predominantly electrons and protons, and typically take between ten minutes and several hours to arrive at Earth.

Coronal mass ejections (CME) are often associated with flares and are a focus of space weather forecasting. They can take days to reach the Earth and can disturb the Earth’s magnetic field and ionosphere, which is where the Earth’s atmosphere meets space, causing what is known as a geomagnetic storm.

Strong geomagnetic storms have the potential to impact GPS, radio frequencies and some satellite operations but forecasting their arrival can give industries time to mitigate against the worst impacts. They are also the phenomena responsible for the enhanced Aurora Borealis in the Northern Hemisphere or Aurora Australis in the Southern Hemisphere. Find tips on how to take photos of the auroras, courtesy of the Royal Photographic Society.

Image: Richard Ellis, Royal Photographic Society

Last year, the announcement of the Vigil mission highlighted an opportunity to enhance space weather forecasting across the world.

Does space weather link with our weather?

Space weather doesn't interact with the Earth's meteorological drivers and doesn't impact day-to-day forecasting, short of people being more interested in clear skies to see the Northern Lights.

Over a longer period, the impact the solar cycle on global temperatures is negligible and can be responsible for less than 0.05°C differences in global temperature over the course of the 11-year solar cycle. For comparison, global average temperatures have risen by around 1.1°C since the industrial revolution, driven by human-induced climate change.

Date Created
April 2023

What's the pollen forecast this year?

Description

Spring weather for many people means some warmer weather, April showers and seeing wildlife awaken from a winter slumber. However, for the one-in-five that suffer from hay fever, it can be the start of months of sneezing, watering eyes and keeping a keen eye on the pollen forecast.

After the wettest March in over 40 years for England and Wales, some are now wondering what the weather we've seen so far could mean for the release of pollen this year, with 'very high' forecasts for tree pollen already for some areas of the UK.

What's the pollen outlook?

The majority of hay fever sufferers are allergic to grass pollen, which can start as early as May and generally peaks in June and July. At present, the focus is on tree pollen, which a minority of people are allergic to, but can still cause some potent hay fever symptoms for those with the allergy.

Yolanda Clewlow is the Met Office's Relationships Manager for Health & Air Quality, and the UK Pollen Forecast Manager. Speaking to the Weather Snap podcast, she said: "We're constantly monitoring what's in the atmosphere and what might be coming, in terms of pollen in the air.

"We look at a very broad picture for the pollen outlook, including the weather in the previous year when pollen is formed on some plants to make a judgement on how bad a season might be for pollen release."

At the time of writing, birch pollen is predominantly in focus, with very high levels expected, particularly in England and Wales.

Yolanda added: "Tree pollen is the main factor in the forecast at the moment, and this week, with more settled conditions, we're expecting a large amount of birch pollen in the air, but these different types of tree pollen in the air will shift as we head towards summer."

The changing types of pollen

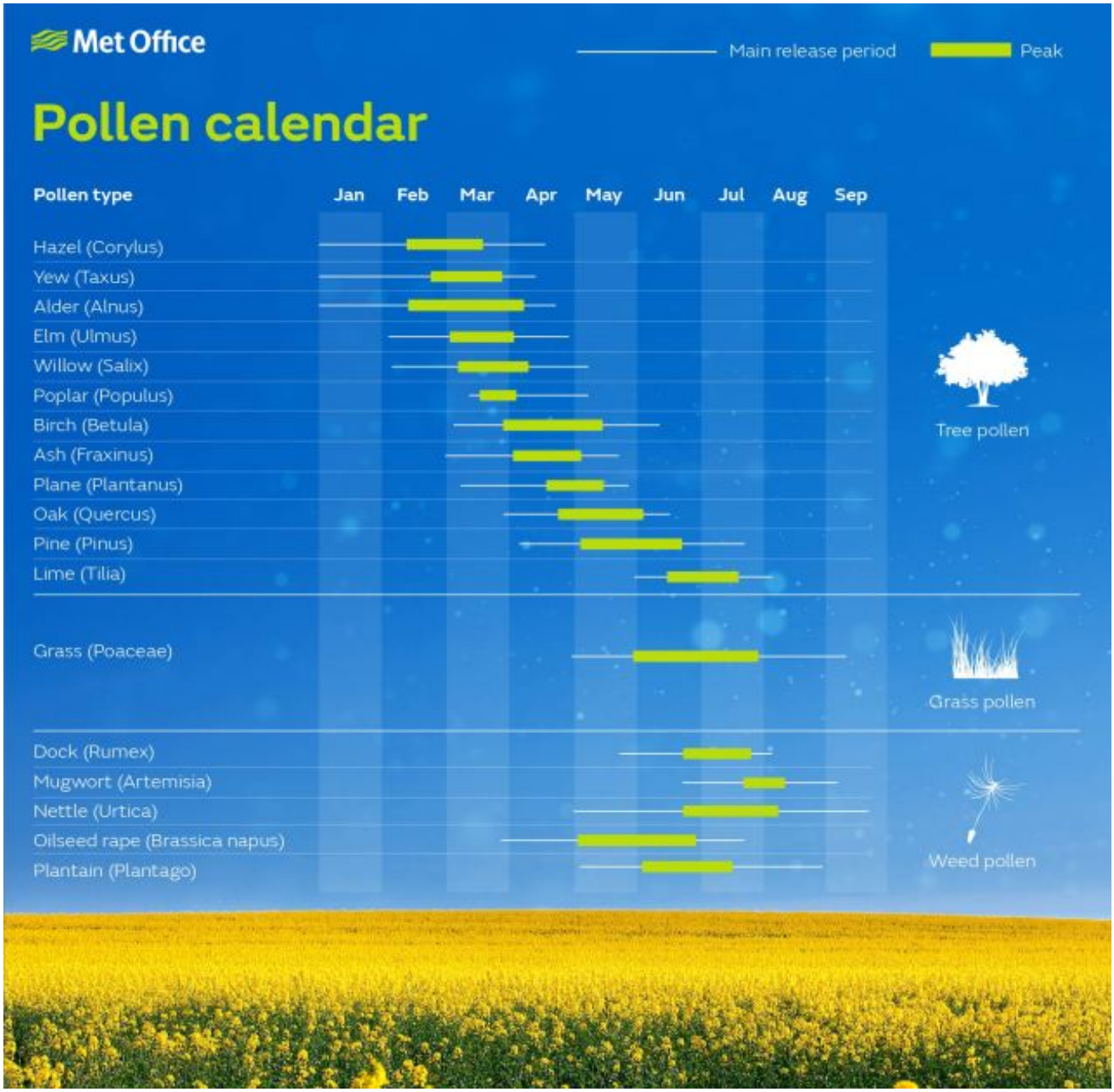
The pollen season is broadly split into three phases, with trees generally the first to release pollen, then grass, followed by weeds.

"The pollen seasons aren't distinct and there's obviously a lot of overlap with different types in the air," said Yolanda.

"It's not possible to forecast for the whole pollen season at this range, but we're expecting a large amount of tree pollen in the air in the coming weeks, then we'll be continuing to keep a close eye on the grass pollen generation and release in the coming months."

In general, pollen production can be more significant in a warm and wet spring and early summer. This

would then need to be released in breezy and dry conditions to create the most significant impacts.



How to manage hay fever

Although many have no adverse reaction to pollen in the air, for those who do suffer with hay fever, there are some steps that can be taken to minimise the impact.

According to Yolanda, the best defence is avoiding the allergen as much as possible in the first place.

“The first thing to do is to make sure you understand the type of pollen you’re allergic to and monitoring the forecast. That way, you know when the very high days of pollen are coming and you can take precautions to try and avoid the pollen. However, it’s not possible to avoid it altogether so for some it’s about taking that preventative medication and planning your day to try and avoid being out in the pollen at the peak times.”

Pollen levels generally peak at the start and the end of the day. During a warm day, pollen gets carried higher in the atmosphere and often goes beyond the range a human would breathe it in. This means the middle of the day can often have fewer pollen grains in the air.

As temperatures cool down in the evening, these levels can pick up again as pollen drifts back towards the level of atmosphere that we breathe in.

“It’s also important to think about what things you have in the atmosphere when those pollen levels are at their peak during the day. Think about whether you want your washing outside, or anything that can be outside picking up pollen and bringing it inside, whether that’s your hair, your washing or your pets.”

Pets can also be affected by hay fever, and in severe cases vets can often prescribe medication to help furry friends through the summer.

Find more advice on dealing with hay fever as part of WeatherReady with the Met Office.

Pollen and climate change

With global temperatures increasing as a result of human-induced climate change, the pollen season in the UK isn’t immune to the effects of a changing climate.

Climate models suggest an increasing likelihood of warmer, wetter winters and hotter drier summers, which will influence the release of pollen into the atmosphere.

Yolanda added: “We’re already seeing an impact on the pollen season as a result of climate change. Some species are having longer seasons, some are starting earlier and some are more severe. We’re also looking at invading species as we anticipate that more species from outside the UK will begin to be able to take hold here and release pollen.”

Get pollen alerts directly to your phone on the Met Office app, or visit the pollen forecast on the Met Office website.

Yolanda was speaking to the Met Office’s Weather Snap podcast, available from 21 April wherever you get your podcasts.

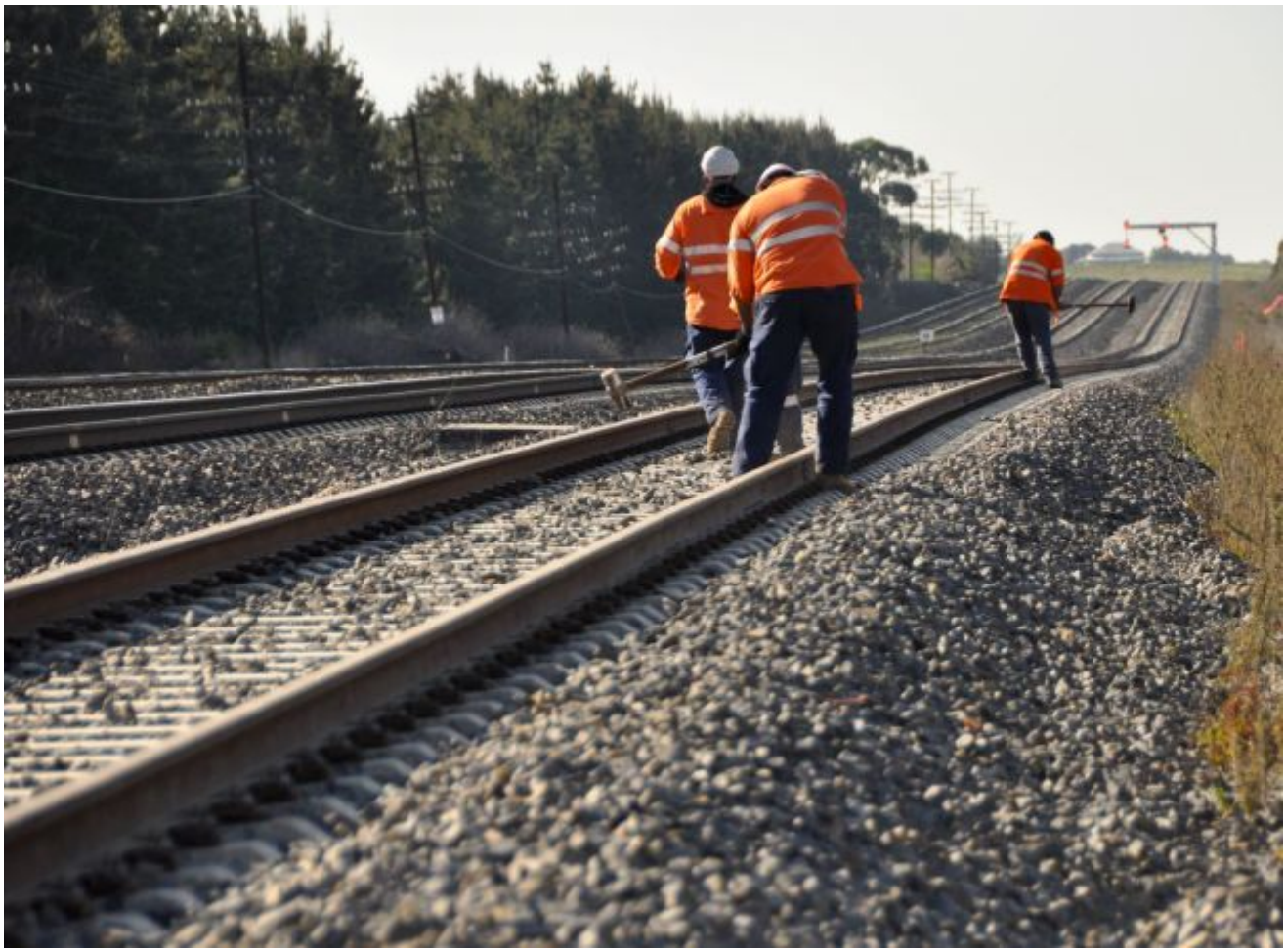
Date Created
April 2023

How does the weather impact the railways?

Description

Like any infrastructure, the rail network can be impacted by external factors such as the weather. Met Office scientist, Alice Lake, is part of a team developing a new temperature model designed to help rail networks in the UK minimise these impacts.

The underlying infrastructure
In the past, the UK rail network was made up of tracks laid in separate panels, bolted together. But traditional track joints require significant maintenance; rail ends wear, and bolts need periodic checking and tightening. Therefore, as steel production and manufacturing processes improved, the lengths of the panels progressively increased until the 1960s when the first continuous welded rail was laid, eliminating track joints altogether. Today, continuous welded rail is used as standard across the UK network.



The weather impacts

Since the steel on railway tracks is essentially a very long piece of metal, it can expand or contract

significantly in hot and cold weather. Therefore, to increase resilience, rails are pre-stressed to withstand the range of temperatures they'll typically experience. The so-called 'stress-free temperature' (SFT) is the temperature at which the rail is neither in tension nor compression. In the UK, the SFT is 27°C. Other countries may choose higher SFTs – for example, in the US standard SFTs range between 35 and 43°C – which allows their rail to withstand hotter temperatures before expanding. However, this also means that their rails are more susceptible to brittleness and cracks in low winter temperatures.

If the rail temperature exceeds the range in which it is designed to operate, the steel can expand substantially, generating forces which push and pull the railway out of shape. Combined with the forces generated by trains running at high speeds along the tracks, this can lead to buckling. While rare, derailment caused by track buckling can have catastrophic consequences, so blanket speed restrictions are implemented across the UK network when the air temperature is forecast to exceed a set threshold.

Using science for informed decision-making

However, there isn't a simple relationship between rail temperatures and air temperature. Therefore, at the Met Office, we're currently developing a new rail surface temperature model, working with key partners to understand their needs. This model uses forecasts of local atmospheric weather parameters (such as air temperature, incoming shortwave and longwave radiation, and amount of precipitation) from numerical weather prediction (NWP) models and then calculates the incoming and outgoing energy at the rail surface. From this, we are able to produce forecasts of local rail surface temperatures. With accurate and precise knowledge of rail surface temperatures, speed restrictions and other preventative measures (such as painting rails white to reduce overheating) could be applied in a more localised and targeted way, minimising disruption to the network.

A changing climate

The latest UK Climate Projections (UKCP18) indicate that we can expect hotter, drier summers as our climate continues to change. Services such as the rail surface temperature model will therefore continue to be critical to ensure industry and business can remain resilient to current and future weather impacts.

Date Created
April 2023

Climate action – taking corporate responsibility

Description

During April, we have been focusing on the topic of climate change and infrastructure, considering the impact of the climate on industries such as energy and transport. In this blog post, we look at this topic at a more local level, sharing information on some of the actions the Met Office is taking to reduce the impact of transport on the climate.

The Met Office Journey to Net Zero strategy includes a focus on business travel and, when our updated baseline is published soon, commuting will also form part of our aim to be a carbon neutral organisation by 2030. As well as reducing business travel, we have also been making changes to our vehicle fleet including both pool cars and bikes. This not only supports our Journey to Net Zero, but also the Greening Government Commitments that one hundred percent of the government car and van fleet will be fully zero emissions at the tailpipe by 31 December 2027.

A greener pool

Two electric pool cars will soon be available for use at our Exeter headquarters for occasions when colleagues need to use this form of transport for business. With charging stations on site (including a number for people to use for personal electric vehicles), this will reduce our reliance on petrol/diesel cars.

At the end of 2022, we also took delivery of a new pool bike fleet at the Exeter office. These include six Ridgeback Avenida bikes and two Ridgeback rechargeable Electron bikes in a variety of sizes to suit different riders. These bikes can be booked for business journeys and leisure rides as well as for emergency transport (e.g., if public transport or car sharer is unexpectedly unavailable) and to try out commuting by bike.

Encouraging low carbon commuting

To assess the climate impact of commuting as well as business travel, a recent staff survey was conducted to help us better understand people's commuting habits. Cycling was our second most common commute method, with many staff making a great effort to use greener travel options; in 2022 we were deserved winners of the National and Global Cycle September Challenge organised by Love to Ride.

In 2022 the Met Office won the National and Global Cycle September Challenge organised by Love to Ride. Image: Shutterstock

The Met Office has long encouraged cycling to work, with excellent facilities available including over 300 covered cycling spaces at our Exeter headquarters along with showers and locker facilities. We are also part of a Cycle to Work scheme to help colleagues spread the cost of buying a bicycle and save on tax and national insurance. More recently, the Met Office has joined the Co Bikes Corporate Rider scheme ensuring our employees can get a discount when using Co Bikes, Exeter's on-demand electric bike scheme.

Local infrastructure

Cycling and walking are often promoted as the most sustainable form of transport, but the infrastructure needs to be in place to facilitate these options. As well as considering the infrastructure available at our offices, we also contribute where possible to local proposals. Last month, for example, we provided a detailed response to a Devon County Council consultation on the Local Cycling and Walking Infrastructure Plan. As well as providing some scientific context, we also commented on considerations for walking and cycling routes including taking into account the needs of those who have physical disabilities and other accessibility requirements. We look forward to seeing the results of the consultation.

Win-wins

As well as the climate benefits of reducing emissions by walking and cycling more, these activities also have co-benefits. These win-wins include reducing air pollution and personal health and wellbeing

benefits. Next month we will be looking in more detail at the co-benefits of climate action. Follow #GetClimateReady on Twitter to learn more about our monthly topics.

Date Created
April 2023

2022: a year in global climate

Description

Today, the World Meteorological Organization (WMO) has released the State of the Global Climate report 2022. In an exclusive interview with the Met Office Omar Baddour – the WMO's head of Climate Monitoring and Policy Services – discussed the latest findings.

The report focuses on key climate indicators, including greenhouse gases, temperatures, sea level rise, ocean heat and acidification, sea ice and glaciers. On the Met Office's *Weather Snap* podcast Omar shared some of the report's findings.

It is fair to say that the State of the Global Climate report for last year – with its litany of negative indicators – makes unpleasant reading for all those concerned about the impacts of climate change.

Omar said: "I would say that 2022 was the busiest year in terms of extreme weather events, with member states reporting around 500 extreme weather and climate events worldwide." The duration of these events varies from the brief ferocity of tropical cyclone Ian which wrought havoc on the southern United State and Cuba to the long-term drought in East Africa which Omar regards as the worst in four decades. Of course, both of these events and hundreds of others too brought considerable humanitarian impacts with the tragedy of loss of life and damage to local communities and infrastructure.

With searing temperatures affecting many nations from the UK to India and Pakistan, 2022 will be remembered by many as the year of the heatwave. The increasing intensity of heatwave is no surprise to Omar. He said: "The heat waves are the most evident sign of climate change because they are directly associated with increasing temperature; and increasing temperature is directly associated with increasing greenhouse gas concentration; which in turn are associated with human anthropogenic factors.

"This is why, for instance, we are reaching records which have been never recorded in the past, like in Europe, but also in many parts of the world in the East Asia, in the Middle East, in North America and so forth.

"So, with the current trend of carbon-dioxide emissions and greenhouse gas concentration increasing, we can only say that the frequency, unfortunately will still be going on in the future if nothing is done to accelerate the mitigation efforts."

The WMO press release emphasises the following key indicators:

- Drought, floods and heatwaves affect large parts of the world and the costs are rising
- Global mean temperatures for the past eight years have been the highest on record
- Sea levels and ocean heat content are at record levels
- Antarctic sea ice falls to lowest extent on record

- Europe shatters records for glacier melt

The Met Office along with a large number of National Meteorological and Hydrological Services are key contributors to the report.

For the interview with Omar Baddour listen to the latest Weather Snap podcast.

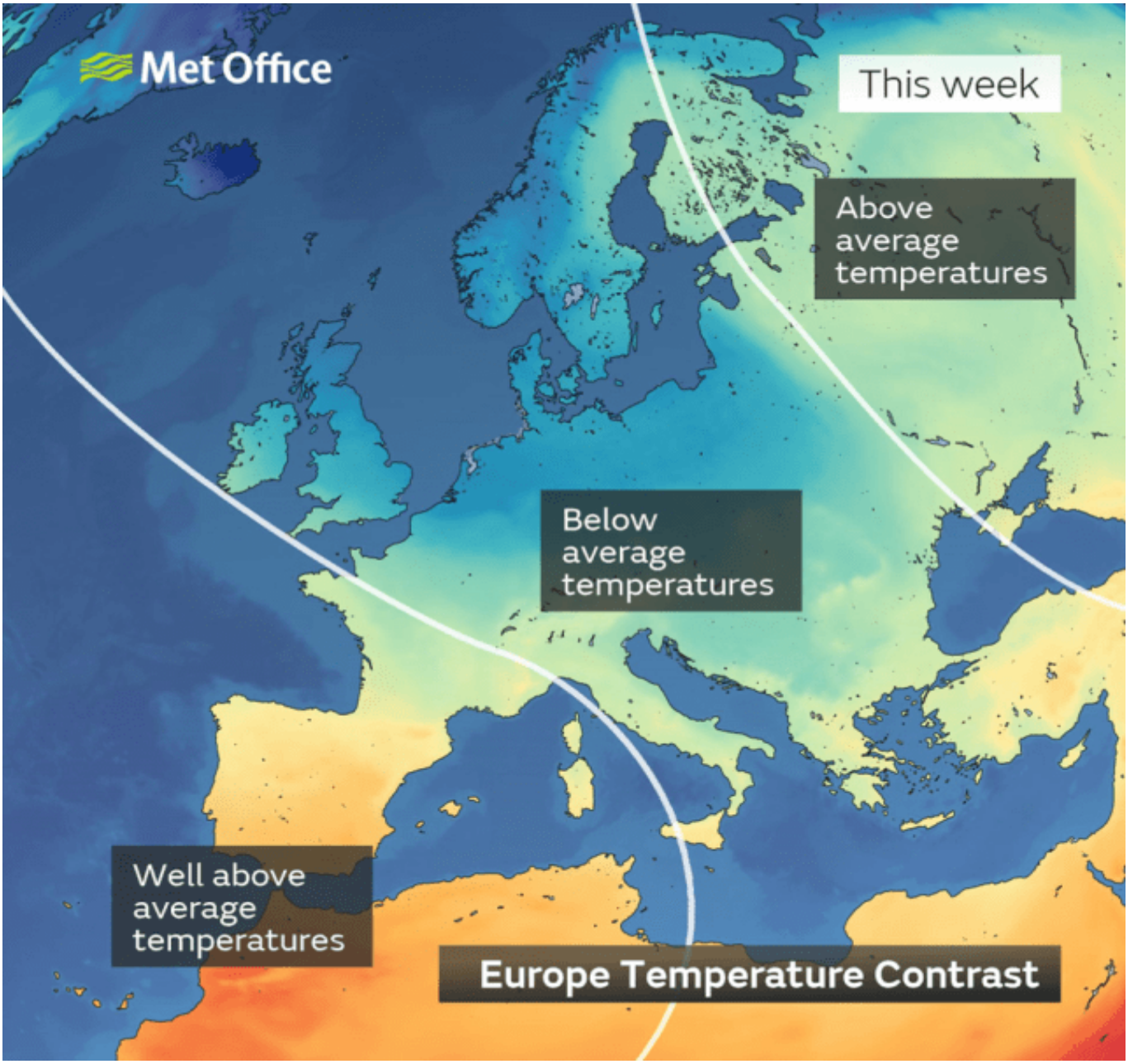
Date Created
April 2023

Spanish heat to build this week

Description

From Britain to Gibraltar, this week Europe will witness a large temperature contrast.

In the south of Spain, high temperatures are forecast to approach or even exceed record-breaking levels for April, while in the UK a temperature plunge this week has seen temperatures well below average for the time of year.



Paul Hutcheon is a meteorologist with the Met Office Global Guidance Unit. He said: “By Thursday and

Friday there is the potential for record-breaking temperatures in Spain, with inland areas like Córdoba expected to reach 15 degrees above normal with highs of around 40 °C degrees.

“Even coastal areas like Gibraltar could see temperatures 10 °C above average.

“In contrast, parts of northern Britain will have seen overnight temperatures this week around six degrees below average.”

What is driving these contrasts?

In Iberia there are four principal factors to explain the extreme heat:

- Weather patterns across North Africa are pushing heat out of the areas of the western Sahara, like Mali and Mauritania, into Europe
- An area of high pressure already over Iberia is suppressing rainfall while the clear skies allow more of the sun’s radiation to reach the ground
- The high pressure pushing down is warming the air, a little like the air in a bicycle pump
- The relative dry conditions and absence of rainfall is causing temperatures to rise. Soils with a higher moisture content dissipate heat energy through evaporation. In contrast, already dry soils can only absorb more heat

Nick Silkstone is a Deputy Chief Forecaster at the Met Office. He said: “In contrast to the increasingly high temperatures in Spain, the UK’s temperatures have been much colder than average with some locations experiencing overnight frosts. An area of low pressure moving away eastwards away from the UK has allowed cold Arctic air to spread south across the UK.

“Although temperatures will increase in much of Britain by the end of the week, conditions in the far north are still expected to remain colder than average.”

Will it get hotter?

Paul Hutcheon added: “Although we are talking about the potential for record-breaking temperatures for April, of course summer temperatures can be much higher. It is too early to say what these spring extreme temperatures will mean for the values in summer. But the dry ground will mean that further heatwave conditions have the potential to lead to even higher temperatures later in the year.”

Date Created
April 2023

El Niño on the way?

Description

Every few years the climate undergoes natural fluctuations, centred in the equatorial Pacific Ocean but with global consequences. These El Niño–Southern Oscillation (ENSO) events involve changes in seawater temperatures and atmospheric pressures across the central and eastern tropical Pacific Ocean and result in warm El Niño phases and cold La Niña phases that each occur every few years and reach peak intensity in northern hemisphere winters.

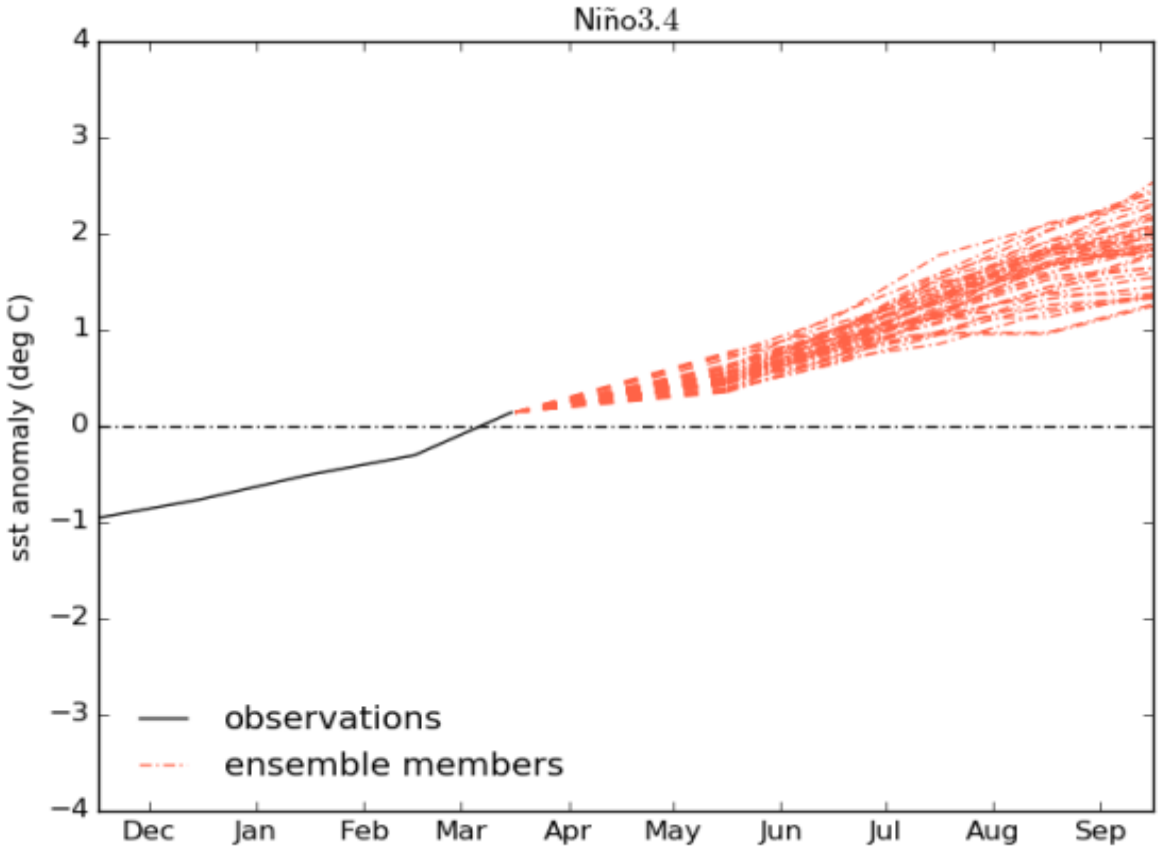


Figure 1: Met Office ENSO forecasts for the coming period showing rapid increase in Pacific Ocean temperature anomalies and the possibility of a large El Nino event (>2 degrees) this year. The observed data (black) and multiple ENSO forecasts (red) are plotted relative to normal conditions in the region (averaged over 1991-2020)

The last three winters have seen a run of three consecutive La Niña events. This run of events, though unusual, has earlier precedents in the historical climate record, for example in 1999, 2000 and 2001 but this has now come to an end. Instead, our latest long-range forecasts suggest that the tropical Pacific is about to transition into El Niño – the warm phase of ENSO.

The figure shows our very latest forecasts for the sea surface temperature anomaly in the equatorial Pacific Ocean. The forecasts all indicate a sharp rise from the current neutral state to El Niño conditions (+0.5°C anomaly) by Summer this year. While there is still considerable uncertainty in the magnitude of the event, some of these latest forecasts also suggest that a large El Niño event is possible, with sea surface temperatures in some forecasts reaching more than 2 degrees above normal by the Autumn.

What does this mean for climate worldwide?

Both historical observations and our physics-based computer models show that El Niño brings increased risk of drought to South-East Asia, India, North-Eastern Australia and parts of the Amazon and southern Africa and increased risk of cold conditions to northern Europe in winter. We will be looking carefully at these regions with our colleagues at other national meteorological services as El Niño develops and updated forecasts become available.

In addition to these regional impacts, ENSO also affects global temperatures and in the year following its northern hemisphere winter peak, El Niño tends to be followed by a rise in global average temperature. This is much smaller than the current level of global warming of around 1.2 degrees that we have now accrued due to climate change but it can make all the difference in terms of breaking new records.

Professor Adam Scaife, Head of Long-Range Forecasting at the Met Office said, “The current record for global temperature occurred in 2016 and it’s no coincidence that followed the last big El Niño. If we get a big El Niño at the end of this year then, we’re likely to break the record for global temperature in 2024.”

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